APPENDIX A

Acronyms, Abbreviations, Symbols, and Notation

Appendix A

Acronyms, Abbreviations, Symbols, and Notation

A.1.0 Acronyms And Abbreviations

AA	Atomic absorption
ASCII	American Standard Code for Information Interchange
ASTM	American Society for Testing and Materials
CCM	Constant capacitance (adsorption) model
CDTA	Trans-1,2-diaminocyclohexane tetra-acetic acid
CEAM	Center for Exposure Assessment Modeling at EPA's Environmental Research Laboratory in Athens, Georgia
CEC	Cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DLM	Diffuse (double) layer (adsorption) model
DDLM	Diffuse double layer (adsorption) model
DOE	U.S. Department of Energy
DTPA	Diethylenetriaminepentacetic acid
EDTA	Ethylenediaminetriacetic acid
EDX	Energy dispersive x-ray analysis
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
HEDTA	N-(2-hydroxyethyl) ethylenedinitrilotriacetic acid
HLW	High level radioactive waste
IAEA	International Atomic Energy Agency
ICP	Inductively coupled plasma
ICP/MS	Inductively coupled plasma/mass spectroscopy
IEP (or iep)	Isoelectric point
LLNL	Lawrence Livermore National Laboratory, U.S. DOE
LLW	Low level radioactive waste
MCL	Maximum Contaminant Level
MEPAS	Multimedia Environmental Pollutant Assessment System
MS-DOS®	Microsoft® disk operating system (Microsoft and MS-DOS are register trademarks of Microsoft Corporation.)
NPL	Superfund National Priorities List
NRC	U.S. Nuclear Regulatory Commission
NWWA	National Water Well Association
OERR	Office of Remedial and Emergency Response, U.S. EPA
ORIA	Office of Radiation and Indoor Air, U.S. EPA
OSWER	Office of Solid Waste and Emergency Response, U.S. EPA

PC	Personal computers operating under the MS-DOS® and Microsoft® Windows operating systems (Microsoft® Windows is a trademark of Microsoft Corporation.)
PNL	Pacific Northwest Laboratory. In 1995, DOE formally changed the name of the Pacific Northwest Laboratory to the Pacific Northwest National Laboratory.
PNNL	Pacific Northwest National Laboratory, U.S. DOE
PZC	Point of zero charge
RCRA	Resource Conservation and Recovery Act
SCM	Surface complexation model
SDMP	NRC's Site Decommissioning Management Plan
TDS	Total dissolved solids
TLM	Triple-layer adsorption model
UK	United Kingdom (UK)
UK DoE	United Kingdom Department of the Environment
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation

A.2.0 List of Symbols for the Elements and Corresponding Names

Symbol	Element	Symbol	Element	Symbol	Element
Ac	Actinium	Gd	Gadolinium	Po	Polonium
Ag	Silver	Ge	Germanium	Pr	Praseodymium
Al	Aluminum	H	Hydrogen	Pt	Platinum
Am	Americium	He	Helium	Pu	Plutonium
Ar	Argon	Hf	Hafnium	Ra	Radium
As	Arsenic	Hg	Mercury	Rb	Rubidium
At	Astatine	Ho	Holmium	Re	Rhenium
Au	Gold	I	Iodine	Rh	Rhodium
B	Boron	In	Indium	Rn	Radon
Ba	Barium	Ir	Iridium	Ru	Ruthenium
Be	Beryllium	K	Potassium	S	Sulfur
Bi	Bismuth	Kr	Krypton	Sb	Antimony
Bk	Berkelium	La	Lanthanum	Sc	Scandium
Br	Bromine	Li	Lithium	Se	Selenium
C	Carbon	Lu	Lutetium	Si	Silicon
Ca	Calcium	Lw	Lawrencium	Sm	Samarium
Cb	Columbium	Md	Mendelevium	Sn	Tin
Cd	Cadmium	Mg	Magnesium	Sr	Strontium
Ce	Cerium	Mn	Manganese	Ta	Tantalum
Cf	Californium	Mo	Molybdenum	Tb	Terbium
Cl	Chlorine	N	Nitrogen	Tc	Technetium
Cm	Curium	Na	Sodium	Te	Tellurium
Co	Cobalt	Nb	Niobium	Th	Thorium
Cr	Chromium	Nd	Neodymium	Ti	Titanium
Cs	Cesium	Ne	Neon	Tl	Thallium
Cu	Copper	Ni	Nickel	Tm	Thulium
Dy	Dysprosium	No	Nobelium	U	Uranium
Er	Erbium	Np	Neptunium	V	Vanadium
Es	Einsteinium	O	Oxygen	W	Tungsten
Eu	Europium	Os	Osmium	W	Wolfram
F	Fluorine	P	Phosphorus	Xe	Xenon
Fe	Iron	Pa	Protactinium	Y	Yttrium
Fm	Fermium	Pb	Lead	Yb	Ytterbium
Fr	Francium	Pd	Palladium	Zn	Zinc
Ga	Gallium	Pm	Promethium	Zr	Zirconium

A.3.0 List of Symbols and Notation

α	Dispersivity in the x, y, or z direction
α'	Capacity factor or ratio of the moles per unit volume of water-saturated solid, C_s, to the moles per unit volume of liquid, C_l
γ	Activity coefficient
δ	Constrictivity of the porous media
δ'	Mass-related constant
ϵ	Parameter in Dubinin-Radushkevich isotherm model equal to "RT 1n $(1 + 1/C_i)$"
λ	First-order degradation/decay coefficient
θ	Volumetric water content
θ_m	Volume fraction of water associated with the mobile domain
θ_v	Total water content
θ_{vz}	Moisture content in the vadose zone
μ	Mobility
ρ_b	Bulk density
$\rho_{particle}$	Particle density
σ	Net charge associated with the surface of adsorbing mineral as conceptualized in electrostatic adsorption models
σ_d	Charge associated with the diffuse layer d of counterions as conceptualized in electrostatic adsorption models
σ_β	Charge associated with the β layer as conceptualized in electrostatic adsorption models
σ_o	Charge associated with the o layer as conceptualized in electrostatic adsorption models
σ_s	Surface charge at the Stern layer
σ_{sd}	Standard deviation associated with the Gaussian solution
τ	Tortuosity of the porous media
υ_x	Pore velocity in direction x
ϕ	Porosity
ϕ_ϵ	Effective porosity
ϕ_m	Mobile water fraction as defined by the ratio of the volume fraction of water associated with the mobile domain, θ_m, to the total water content, θ_v
ψ	Electrical potential
ψ_d	Potential at the diffuse layer
ψ_o	Potential at the surface (plane *o*)
ψ_s	Potential at the Stern layer
A	Concentration of free or unoccupied surface absorption site on a solid phase
ads	Adsorption
A_i	Concentration of adsorbate (or species) I on the solid phase at equilibrium
A_m	Adsorption capacity of adsorbent per unit mass
am	Amorphous

aq	Aqueous
C	Radioactivity of tracer on sediment
C	Constant capacitance term
CEC	Cation exchange capacity
C_i	Concentration of adsorbate (or species) I in solution at equilibrium
C_l	Moles per unit volume of liquid
C_{om}	Concentration of organic material
C_s	Moles per unit volume of water-saturated solid
C_T	Total mass at the site per total site volume
C_{Tp}	Total mass at the site per dry weight of soil
D	Proportionality constant or diffusion coefficient
D*	Dispersion coefficient in the x, y, and z directions adjusted for retardation with the retardation factor
D_a	Apparent diffusion coefficient
D_e	Effective diffusion coefficient
D_i	Intrinsic diffusion coefficient
D_{mech}	Mechanical dispersion
D_{mol}	Molecular diffusion coefficient
D_p	Diffusion coefficient for a species within a porous media
D_x	Dispersion coefficient in direction x
e^-	Free electron
$e^{-\psi F/RT}$	Boltzmann factor
Eh	Redox potential of an aqueous system relative to the standard hydrogen electrode
F	Faraday constant, 23,060.9 cal/V·mol
f_{oc}	Fraction (w/w) of organic material in soil
$\Delta G^\circ_{f,298}$	Gibbs free energy of formation at 298 K
$\Delta G^\circ_{f,T}$	Gibbs free energy of formation at temperature T
$\Delta G^\circ_{r,298}$	Gibbs free energy of reaction at 298 K
$\Delta G^\circ_{r,T}$	Gibbs free energy of reaction at temperature T
^3H	Tritium
H_1	Thickness of the vadose zone
h_m	Mixing-zone thickness
$\Delta H^\circ_{f,298}$	Enthalpy (or heat) of formation at 298 K
$\Delta H^\circ_{f,T}$	Enthalpy (or heat) of formation at temperature T
$\Delta H^\circ_{r,298}$	Enthalpy (or heat) of reaction at 298 K
$\Delta H^\circ_{r,T}$	Enthalpy (or heat) of reaction at temperature T
I	Ionic strength
IAP	Ion activity product
J_{ix}	Flux of species I in direction x
K	A constant in the Langmuir, Freundlich and Dubinin-Radushkevich isotherm models
K_{DR}	Concentration-based, conditional equilibrium constant calculated from Dubinin-Radushkevich adsorption isotherm

K_d	Concentration-based partition (or distribution) coefficient
K_d^{act}	Activity-based partition coefficient
K_{dis}	Dissolution equilibrium constant
K_{ex}	Exchange reaction constant
K_F	Concentration-based, conditional equilibrium constant calculated from Freundlich adsorption isotherm
K_F^{act}	Activity-based, conditional equilibrium constant calculated from Freundlich adsorption isotherm
K_L	Concentration-based, conditional equilibrium constant calculated from Langmuir adsorption isotherm
K_L^{act}	Activity-based, conditional equilibrium constant calculated from Langmuir adsorption isotherm
K_{oc}	Organic-carbon partition coefficient
K_{om}	Organic-matter partition coefficient
$K_{r,298}$	Equilibrium constant at 298 K
$K_{r,T}$	Equilibrium constant at temperature T
$K_{sp,T}$	Solubility product
l	Liter
M	Generic term for metal or radionuclide constituent
m	Meter
M_A	Instantaneous mass released per unit area
M_{ads}	Mass of constituent I associated with the adsorbed phase in the vadose zone
M_{aq}	Mass of constituent I associated with the aqueous phase in the vadose zone
M_{rel}	Released mass
$M_{saturated}$	Total mass of constituent I associated with the saturated zone
M_{sed}	Sediment mass
M_{Total}	Total combined mass of constituent I in the vadose and saturated zones
M_{vadose}	Total mass of constituent I associated with the vadose zone
ml	Milliliter
mol	Mole
mV	Millivolt
N	Constant in the Freundlich isotherm model
n	Total porosity
n_e	Effective porosity
pE	Negative common logarithm of the free-electron activity
pH	Negative logarithm of the hydrogen ion activity
pH_{zpc}	pH for zero point of charge
R	Ideal gas constant, 1.9872 cal/mol·K
R_f	Retardation factor
s	Solid phase species
SI	Saturation index, as defined by log ($IAP/K_{r,T}$)
SOH	Unreacted surface site occupied by a hydroxyl group

SOH·M	Used in the non-electrostatic adsorption models for an adsorption site occupied by component M or surface-bound metal
SO·M	Used in the electrostatic adsorption models for an adsorption site occupied by component M or surface-bound metal
T	Absolute temperature, usually in Kelvin unless otherwise specified
T_σ	Total surface charge for plane *o*
t	Time
t_{max}	End of the break-through curve during a column experiment
t_{min}	Beginning of the break-through curve during a column experiment
t_{pulse}	Mean residence time of a solute during a column experiment for a pulse release
t_T	Total advective travel time of the contaminant
t_{ss}	Mean residence time of a solute during a column experiment for a steady-state release
t_{step}	Mean residence time for a step input/release
TDS	Total dissolved solids
V_{source}	Volume associated with the contaminated source
V_w	Volume of water (or adsorbate solution)
v*	Contaminant velocity
v_c	Contaminant velocity
v_d	Darcy velocity
v_p	Pore-water velocity
X_{Gf}, Y_{Gf}, Z_{Gf}	Green's functions (which are orthogonal) in the x, y, and z directions, respectively
x	Distance in the x direction
y	Off-centerline distance
Z	Valence state
z	Charge of ion
{ }	Activity
[ ]	Concentration